The Diffusion of Development: Along Genetic or Geographic Lines?

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THE DIFFUSION OF DEVELOPMENT: ALONG GENETIC OR GEOGRAPHIC LINES?*

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Abstract

Why are some peoples still poor? Recent research suggests the possibility that some societies may be poor due to their genetic endowments, which are found to be a significant predictor of development even after controlling for an ostensibly exhaustive list of geographic and cultural variables. We find, by contrast, that the impact of genetics on living standards is not robust to the inclusion of basic geographic controls.

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Keywords: Genetics, Economic Development, Geography, Climatic Similarity

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I. INTRODUCTION

Why are some peoples still poor? Recently, economic research has begun to investigate the role that genetics plays in the wealth of nations. One prominent example is Spolaore and Wacziarg (2009) — henceforth SW — who argue that the revolution in technological innovation which began in Lancashire cotton textiles circa 1760 spiraled outwards first to the immediate locale, then to the whole of Britain, soon to the entire English-speaking world, and finally to other culturally and *genetically* similar peoples of the world.[1] Today, with the United States at the forefront of the world technological hierarchy, SW find that various distances to the United States, measured geographically, culturally, and genetically, are determinants of a society's level of technology and development.

The authors are careful to point out that the significance of their genetic distance variable, a measure based on the time elapsed since two societies' last common ancestor developed by Cavalli-Sforza *et. al.* (1994), does not necessarily imply any direct influence of genetics on income, but could likely proxy cultural barriers to technological diffusion. However, the authors report that genetic distance "has a statistically and economically significant effect on income differences across countries, even controlling for measures of geographical distance, climatic differences, transportation costs, and measures of historical, religious, and linguistic distance."[2] Were the impact of genetics on development robust to geographic and cultural controls, this would seemingly be evidence in favor of a direct impact of genetics on income, and would be an interesting and important result, in addition to being provocative and heavily-cited.[3]

While the authors deserve credit for introducing a taboo variable into the development discourse, we find that the evidence offered in support of the theory that genetic distance predicts development is sensitive to the inclusion of two simple, intuitive geographic controls: latitude and an Africa dummy.[4] Our findings are consistent with the theory that the technologies developed during the Industrial Revolution diffused first to other temperate regions of the world — where European agricultural technology could be deployed and where the disease environment was most favorable to European people, and thus to their human capital, institutions, technology, seeds, animals and germs. Indeed, this is the theory developed by a long line of scholars, including Kamarck (1976), Crosby (1972, 1986), Diamond (1992, 1997), Sachs (2001), Gallup, Mellinger and Sachs (2000), and Gallup and Sachs (1999) who all stress the importance of climatic similarity for development. In a world with trade costs, where the stability of GDP per capita rankings across decades implies that history matters, and where Malthusian forces have certainly been a strong force historically and are debatably still at play in some developing countries (see Clark, 2008), the nature of agricultural technology diffusion and the historical disease environment will necessarily carry outsized importance for development. The theory as laid out by scholars from Kamarck to Sachs explains why distance from the equator should be a key determinant of prosperity, and empirical growth economists have long since discovered that income and latitude are highly correlated (with Acemoglu, Johnson, and Robinson [2001] and

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[1] Two other examples are Spolaore and Wacziarg (2011), who use the same genetic data and make a similar argument, and Ashraf and Galor (2008), who look at ethnic diversity.

[2] Spolaore and Wacziarg (2009), p. 469.

[3] Indeed, "The Diffusion of Development" was covered in the popular press in a David Warsh column, now is commonly featured on graduate reading lists, including at Harvard, MIT, Tufts, NYU, UC Davis, Stanford, Duke, the Hong Kong Institute of Science and Technology, and many others, and already has roughly 150 citations on google scholar.

[4] Giuliano, Spilimbergo, and Tonon (2006) have found the same thing for just Europe.

Engerman and Sokoloff [1997] providing two additional stories for why this might be), although the mechanism is in dispute.

To our knowledge, no other paper has shown that simple geography controls can account for the puzzling apparent impact of genetics on development.[5]

II. EMPIRICS

In columns (1) and (2) in Table I, we have reproduced the baseline results from SW's Table I, finding that "genetic distance to the US," measured as the amount of time elapsed since the populations in these countries separated, is a significant predictor of income per capita. Yet, while these columns contain "New Trade Theory" geographic controls, they do not contain any "climatic similarity" controls. "Absolute difference in latitude" is included, but "absolute difference in absolute latitude" -- distance from the equator -- is not. The reason why the latter is the appropriate control should be clear: although the Southern Cone countries, South Africa, and Australasia all have very different latitudes than the US, they have similar climates owing to their similar *absolute latitudes* with Europe and the United States. (Appendix Figure A.1 shows the familiar nonlinear relationship between income and absolute difference in latitude with the US.) SW themselves discuss the importance of including climatic similarity variables, writing that latitude could affect income directly, or via technology diffusion, yet climatic similarity variables are curiously omitted as controls from their primary results in Table I.

It might be that "genetic distance" explains why it is that latitude is so highly correlated with development -- that Europeans settled in areas with climates similar to Europe, and these places are now developed owing to their European institutional endowment, superior genes, or human capital. In column (4), however, when we include distance from the equator and a dummy for the 41 Sub-Saharan African nations in our sample -- the very first specification we tried after coding up the dataset -- the coefficient on genetic distance falls substantially, rendering the results insignificant.[6] As distance from the equator is an imperfect proxy for climate, when we include a more precise climate variable, the percentage of each country's land area in the tropics or sub-tropics in column (5), the point estimate falls even further.

One might protest the inclusion of the dummy for Sub-Saharan African nations on the grounds that this is perfectly correlated with the genetic distance variable, but this is actually not the case. Many East African nations, such as Ethiopia, are actually closer to the US genetically in the Cavalli-Sforza data than are some East Asian countries, such as Japan. Secondly, there is more genetic variation within Sub-Saharan Africa than there is in the entire rest of the world. Thirdly, as seen in Table I, latitude and the percentage of land area in the tropics or sub-tropics are still significant at 99.9% when an Africa dummy is included, even though Sub-Saharan African nations generally have a much higher proportion of land in tropical areas. Fourth, as explained in Acemoglu, Johnson and Robinson (2001), Kamarck (1976), Crosby (1972, 1986), Diamond (1992, 1997), and Sachs (2001), among others, Africa is very different from other

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[5] In a coterminous working paper, Luis Angeles (2011) shows that SW's genetic proxy is sensitive to the inclusion of 12 additional linguistic, religious, colonial, geographic *and another genetic control* (percentage of population with European ancestry, not counting mestizos). The inclusion of so many additional controls should lead to a concern about overfitting, while including another genetic variable only serves to strengthen SW's original result, if anything.

[6] A key statistic, although rarely reported, in the refutation of any statistical finding is how many specifications were tried before the results were reversed.

tropical areas in terms of its historical mortality rates, disease environment, pests, biodiversity, and geographic features. The entire region shares various geographic and cultural traits of which we are only controlling for a small subset, and so to "control for geography" one should naturally include dummies for large geographic regions, including Africa. That genetic distance is really just picking up the impact of latitude and the Africa dummy makes the result substantially less interesting.

[Insert Table I]

SW offer evidence (their Table IV) that relative genetic distance to the US is correlated with income differences generally. To show this, they take the difference in per capita GDP for each dyadic combination of 144 countries, manufacturing 10,296 highly dependent data points, and use this as the dependent variable with the regressor of interest now being the relative genetic distance to the US.[7] It should be noted that if genetic distance to the US is not a predictor of income as we found above, then it follows that relative genetic distance to the US between any two countries should not be a predictor of their income differences. We include our Table II in the interest of being thorough.

The first column in Table II benchmarks SW's results, and then in column (2) we show that the inclusion of continent dummies eliminates the result. While SW correctly stress the importance of including continent dummies in their analysis, their novel method of implementing these dummies oddly forces the income difference between North and South America to be the same as the difference between North America and Africa. If instead we allow a separate dummy for each continent pairing -- *i.e.*, a dummy for North America paired with South America, and a separate dummy for South America paired with Africa -- then the results disappear. Including these dummies does not render the "climatic similarity" geography variables insignificant in columns (3) and (4), even though including continent dummies clearly reduces the variation in these variables.

[Insert Table II]

To conclude, the results presented above show that genetic distance as a predictor of development is sensitive to the inclusion of simple geographic controls. Our findings provide additional evidence for the surprising importance of geographic similarity variables, if not the exact mechanism by which these variables impact development. Future research should continue the work of Spolaore and Wacziarg, to introduce creative new variables with the potential to explain why some peoples are poor, and why climatic similarity has been such a strong force historically -- but the answer to this mystery does not lie in our genetic differences.

[7] Just as one might worry about the independence of the original 144 observations, as there is likely to be regional correlation. Those worries are likely to multiply when one creates 10,296 data points based on differencing 144 observations which were unlikely to be independent to begin with. Hence, the bar for significance in Table II is likely to be lower than in Table I, and the standard errors for genetics are generally about half as large.

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TABLE I

Income Level Regressed On Various Distances From the United States, 1995

	(1) Univariate	(2) SW's Baseline Controls	(3) Add Africa dummy	(4) Add distance from equator	(5) Add (%) of land area in tropics and sub-tropics
F_{ST} genetic distance to the United States, weighted	**-14.80775**	**-14.315*** **	**-8.815*** **	**-3.782**	**-1.617**
	(1.493)	(1.958)	(2.579)	(2.738)	(2.844)
Absolute difference in latitude from the United States		1.364**	1.416**	1.218**	1.519***
		(0.589)	(0.542)	(0.489)	(0.529)
Absolute difference in longitude from the United States		0.801*	0.705*	(0.024)	0.339
		(0.434)	(0.382)	(0.393)	(0.359)
Geodesic distance from the United States (1,000s of km)		-0.159*	-0.147*	(0.038)	-0.117*
		(0.086)	(0.077)	(0.075)	(0.068)
=1 for contiguity with the United States		1.002***	0.856***	0.695***	0.395
		(0.173)	(0.187)	(0.168)	(0.255)
=1 if the country is an island		0.464	0.263	0.391	0.448*
		(0.298)	(0.289)	(0.287)	(0.254)
=1 if the country is landlocked		-0.234	-0.259	-0.465**	-0.469**
		(0.227)	(0.222)	(0.200)	(0.213)
Sub-Saharan Africa dummy			-0.907***	-0.838***	-1.269***
			(0.255)	(0.234)	(0.248)
% of land area in tropics and sub-tropics					-1.164***
					(0.219)
Distance from the Equator				0.031***	
				(0.01)	
Constant	9.737***	9.607***	9.375***	8.151***	9.453***
	(0.117)	(0.229)	(0.262)	(0.352)	(0.254)
Observations	144	144	144	144	144
R^2	0.38	0.436	0.472	0.538	0.551

Standard errors in parentheses; *significant at 10%; **significant at 5%; *** significant at 1%.

TABLE II

Paired World Income Difference Regression (Two-way Clustering)

	(1) SW's column 5 in Table IV	(2) Baseline	(3) Adding KCDS variable	(4) Adding KCDS variable
	SW's Continent Dummy	Region by Region fixed effects		
F_{ST} Genetic Distance Relative to the US, Weighted	4.414***	0.35	0.026	-0.141
	(1.229)	(1.161)	(1.158)	(1.147)
Absolute Diff. in Latitude	-0.23	-0.107	-0.479**	-0.231
	(0.228)	(0.201)	(0.238)	(0.207)
Absolute Diff. in Longitude	0.163	0.466**	0.259	0.387**
	(0.14)	(0.178)	(0.161)	(0.16)
Distance	-0.015	-0.029	-0.002	-0.022
	(0.02)	(0.024)	(0.022)	(0.022)
=1 for two countries are contiguous	-0.341***	-0.300***	-0.250***	-0.268***
	(0.073)	(0.065)	(0.06)	(0.062)
=1 for either country is landlocked	0.133*	0.157***	0.166***	0.164***
(0 for both are landlocked)	(0.07)	(0.06)	(0.059)	(0.06)
=1 for either country is island	0.149*	0.077	0.069	0.065
(0 for both are islands)	(0.084)	(0.092)	(0.089)	(0.093)
Absolute Difference in Absolute Latitude			0.009***	
			(0.004)	
Difference in % of land area in Tropics and Sub-Tropics				0.259***
				(0.093)
Observations	10296	10296	10296	10296

Two-way clustered standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.

APPENDIX

Figure A.1